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Working Paper

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Würzburg economic papers, No. 60

Provided in cooperation with:
Julius-Maximilians-Universität Würzburg

Suggested citation: Hock, Thorsten; Zimmermann, Patrick (2005) : Forecasting monetary policy in Switzerland: Some empirical assistance, Würzburg economic papers, No. 60, http://hdl.handle.net/10419/22354

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Würzburg Economic Papers

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FORECASTING MONETARY POLICY IN SWITZERLAND: SOME EMPIRICAL ASSISTANCE

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We would like to thank Dr. Jürg Tobler for his valuable comments.

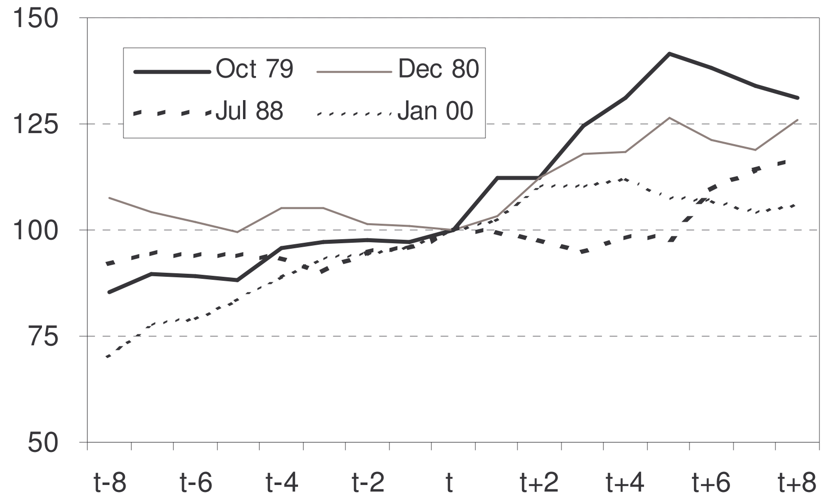
This paper provides empirical assistance in forecasting monetary policy in Switzerland. After the introduction, we provide a descriptive analysis of the four cycles of rising interest rates from 1979 to 2003. It is apparent that the individual cycles diverge to greater or lesser degrees from the average rising interest rate cycle. The third section evaluates the quality of various market forecasts. Regardless of the method of measurement, they show statistically significant and systematic forecast errors. Even simple trend forecasts for money market rates seldom beat the toss of a coin. If we divide the observation periods into regimes of rising and of falling interest rates, then forecasts based on futures contracts on the 3-month LIBOR are superior to other market variables such as forwards or consensus estimates in times when rates are rising. In the fourth section, we assess an empirical response function for the Swiss National Bank's (SNB) monetary policy. Due to the long, variable time lags with which monetary policy affects the real economy, the central banks must adopt a forward-looking approach and base decisions on expectations. Hence by employing consensus forecasts, we use expectations for inflation and growth as explanatory variables. The analysis shows that the SNB has a stable interest rate policy, with inflation forecasts weighted four times more heavily than growth expectations. Assuming the SNB will behave similarly in the future as it did in the past, this rule of thumb allows us to assign historically consistent money market rates to a specific macro-economic climate.

* At the time of this research Mr. Zimmermann was working at Zurich Cantonal Bank

1. Introduction

The success of investors active in the Swiss capital market depends heavily on the timing of the Swiss National Bank's (SNB) monetary policy turnarounds. Not only do money market rates, directly controlled by the central bank, and "short" bond yields go up; yields on long-term bonds should move in tandem with the rise on the money market, although by a smaller amount. Figure 1 shows the trend of the ten-year government bond eight months before and after the first restrictive move by the SNB in the last four interest rate cycles. The lines show the month in which the first interest rate hike took place. In order to enhance comparability, in all phases the capital market rate is rebased to 100 (t) at this time. We observe that capital market rates in general already bottomed out ahead of the turnaround. The central factor in common in all four interest rate cycles is that eight months after the beginning of the restrictive cycle, interest rates were always higher. With the exception of the phase in mid-1988, the increase occurred without interruption.

Figure 1: Trend of ten-year government bond yield at turnarounds



Which tools can an investor use to forecast the SNB's monetary policy? Economists are basically only able to make "conditional" predictions. They must make certain assumptions about the parameters that they consider relevant for the accuracy of their forecasts. Hence in the second section, we attempt to identify the common factors among the past rising interest rate cycles using a descriptive analysis. In the third section we intend to find out how accurate various market forecasts have been in the past in predicting money market rates. In the fourth section we attempt to simulate the behaviour of the Swiss central bank using a response function in order to link the level of money market rates to the economic climate. This report concludes with a summary of the results.

2. Description of the phases of rising interest rates

In this section we will identify and describe the historical rising interest rate cycles. As a basis, we use the SNB's key interest rate (see Figure 2). The last month before the interest rate turnaround and the month in which the cyclical high was reached are listed in Table 1. From 1979 to 2003 we can see four cycles of rising interest rates, which vary considerably in the degree to which rates rose. If one uses three-month rates as a yardstick, the smallest rise, at 2.50%, was observed in the most recent cycle in 2000. In the long period of restrictive monetary policy at the end of the 1980s and the early 1990s, the money market rate leapt by 7.6%. The two cycles show that the extent of the interest rate hikes can fluctuate widely, making the average increase of just over 5% for the cycles an unreliable figure. The time periods between the first and the last interest rate hikes also diverge widely. However, if one excludes the third cycle (when the rising phase lasted 37 months), then key rates were raised to a temporary high within a period of well under one year. This observation suggests that the SNB moves quickly to achieve the targeted interest rate level once it has decided to hike rates. Pinpointing the time when interest rates will turn around is thus extraordinarily important.

Figure 2: Historical development of SNB key rate

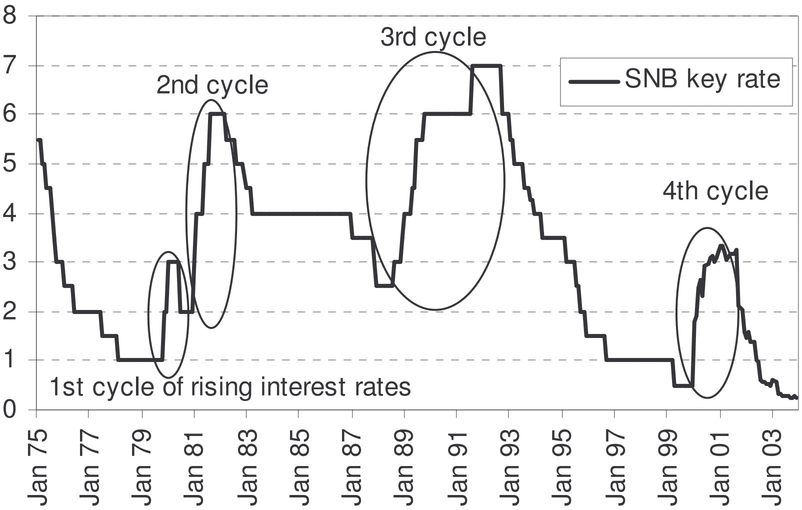


Table 1: Swiss cycles of rising interest from 1979 to 2003

	1st cycle		2nd cycle		3rd cycle		4th cycle		Average	
	Key interest rate	3-month money market	Key interest rate	3-month money market	Key interest rate	3-month money market	Key interest rate	3-month money market	Key interest rate	3-month money market
Cyclical Low	1.00%	1.10%	2.00%	5.50%	2.50%	1.80%	1.25% - 2.25%	1.10%		2.38%
Last month	Oct 79	Jul 79	Dec 80	Nov 80	Jul 88	March 88	Jan 00	Sep 99		
Cyclical High	3.00%	6.20%	6.00%	10.60%	7.00%	9.40%	3.00% - 4.00%	3.60%		7.35%
First Month	Jan 80	May 80	Aug 81	Nov 81	Aug 91	Jun 92	Jun 00	Oct 00		
Magnitude	2.00%	5.10%	4.00%	5.10%	4.50%	7.60%	1.75%	2.50%	3.06%	5.08%
Time in months between cyclical low and high	3	10	8	12	37	51	6	13	13.50	21.50
Lead of money market rates (cyclical low of money market rates vs. low of key interest rates)	3		1		4		4		3	
The turnaround is defined as the first month after the cyclical low.										

3. How good are the market forecasts?

Do the market's expectations form an appropriate basis for making decisions regarding forecasts for money market rates? Do the selected forecasts vary in quality? These are the questions we address in this section. We select the following market expectations for 3-month money market rates as the subject for scrutiny:

(a) Forecasts in 1 to 12 months calculated from the current yield curve (forwards)
(b) Consensus Economics Inc.'s consensus forecasts in 3 and 12 months
(c) Forecasts in 1 to 12 months extrapolated from the futures prices for the 3-month money market rate

Table 2 includes the notations, the sources of the various data and the observation period.

Table 2: Notations

Variable Name	Notation	Source	Period
3-month money market rate	Money3m	SNB	01/89-12/03
Forwards	forwards[t]	SNB and Zurich Cantonal Bank	01/89-12/03
Consensus	cons[t]	Consensus Economics Inc.	12/91-12/03
Futures	ff[t]	LIFFE	12/91-12/03

In order to calculate (a) the forecasts of money market rates based on the yield curve, we derive a yield curve at the end of every month for the entire observation period based on the spot rates (daily rate, weekly rate, 3-month rate, 6-month and 12-month rate) and the swap rates (2-year, 3-year, 4-year, 5-year, 7-year and 10-year par rate). The yield curve is interpolated using a cubic spline function, and simultaneously the par rates are coupon-adjusted so that the present value of every money market investment comes to 100. The forwards for the 3-month money market rate can be determined from the yield curve calculated in this manner as follows:

$$\left(1+F_{t,t+3)}\right)=\left[\left(1+R_{0,t+3}\right)^{t+3}\right]/\left[\left(1+R_{0,t}\right)^{t}\right] \tag{1}$$

whereas: $F_{t,t+3}$ = forward in t for the 3-month rate
$R_{0,t+3}$ = spot rate for the time period 0 to t+3
$R_{0,t}$ = spot rate for the time period 0 to t

The forecast for the 3-month money market rate in 12 months is thus determined using the spot rates for a 15- and a 12-month money market investment, with the spot rates coming from the interpolated yield curve.

Consensus Economic Inc.'s consensus forecasts (b) with a time horizon of three and twelve months are published around mid-month. The difference between the time when the data are compiled and when they are published nevertheless leads to the conclusion that the consensus forecasts, which reach us mid-month, come roughly from the end of the previous month. However, since it is incorrect to assume that this information would have already been available at this earlier time point, we use at the end of the month the forecasts published mid-month as interest rate predictions for the next three or twelve months.

Making interest rate forecasts using futures (c) also requires some calculations since futures on the three-month rate are traded on the LIFFE that only mature every quarter (in March, June, September and December), not monthly. The expiry date is usually a Monday in the middle of the respective month. In our analysis we use the generic future, which has physical futures contracts as a basis but is already rolled on the first day of the expiry month. In the interests of simplicity we have assumed that the price of the generic future at the end of the month preceding the expiry month constitutes an interest rate forecast for the three-month rate in one month's time, even though the exact forecast period tends to be shorter (between twelve and twenty days). If, for example, we are at the end of February and the most recent contract expires in mid-March, the futures price can be interpreted from the generic future on the 28th or 29th of February as a forecast of the three-month rate in one month's time. In order to derive an interest rate forecast valid in two to twelve months, we must make an additional assumption; since other generic futures are based on futures contracts that expire in the following quarters, at the end of February in addition to the forecast for the three-month money market rate in one month, there are also forecasts for the rate in four (expiry in mid-June), seven (expiry in mid-September), ten (expiry in mid-December) and thirteen (expiry in mid-March of the following year) months. Given these market forecasts, we have linearly interpolated the forecasts for the interim months from the corresponding generic futures and, if necessary, from the current three-month money market rate.

In evaluating the three forecast series, we asked the following questions:

(a) Are the forecasts systematically biased upwards or downwards?
(b) How well-suited are the individual data samples for simple trend forecasts?
(c) Does the quality of the various market forecasts differ in phases of rising and falling interest rates?

First we test (a) the three market forecasts for lack of bias.[1] If appropriate, we wish to identify a pattern in the forecast errors. An efficient forecast assumes in the equation

$$\text{Money3m}_t = \alpha + \beta * \text{forecast}_{t\text{-}k} \tag{2}$$

for α values close to 0 and for β values close to 1. Using a simple regression analysis we estimated these two variables in differences for our market forecasts and then tested the null hypothesis α =0 and β=1 applying a Wald test. The null hypothesis could be rejected for the entire period for all the included forecasts (see Table 3). The almost consistently high t values of the various estimates for α signal a high probability of systematic forecast errors. The negative signs suggest that increases have been overestimated and declines underestimated. Furthermore, the error increases as the forecasting horizon lengthens. Measured against the value of α, the forecasts from the yield curve appear to show the smallest forecast error. This is true for all the observed time periods.

Table 3: Test for systematic forecast errors

Variable	Regression coefficients				Wald test	
	α	t-Stat.	β	t-Stat.	F-Stat.	Prob.
ff1	-0.0	-1.7	-0.2	2.2	84.0	0.0
ff3	-0.2	-2.3	0.1	0.5	17.8	0.0
ff6	-0.4	-3.2	0.6	2.2	6.9	0.0
ff9	-0.7	-3.7	0.7	2.2	8.8	0.0
ff12	-0.8	-2.3	0.9	1.7	6.5	0.0
cons3	-0.2	-2.3	0.1	0.6	21.0	0.0
cons12	-0.8	-3.4	0.5	1.8	16.5	0.0
forward1	-0.0	-1.1	-0.1	-1.0	101.7	0.0
forward3	-0.1	-1.4	0.1	0.4	28.7	0.0
forward6	-0.2	-1.8	0.2	0.8	10.1	0.0
forward9	-0.4	-2.1	0.2	0.7	11.2	0.0
forward12	-0.6	-2.5	0.2	0.9	14.0	0.0

How well can the various forecast data (b) recognise the direction in which interest rates will head in future? Once again we use the individual market forecasts and the various forecasting horizons. For the empirical assessment of the quality of the trend forecasts, we carry out an χ^2 test for independence.[2] This investigates to what degree the accuracy of the trend forecast systematically diverges from a random forecast. This test is based on a so-called 2x2 contingency table for each variable that shows the number of correct forecasts in the main diagonal. The combined rate of accuracy can be calculated from the equation $(N_{11}+N_{22})/N$. The test data is asymptotically χ^2-distributed with one degree of freedom. In some cases it is possible that the null hypothesis, i.e. a random forecast, is rejected without the combined rate of accuracy itself being above 50%. This can occur if the status — for example, "forecast falling" — is infrequent but the rate of accuracy is very high, and the other status is more frequent and the rate of accuracy here is less than 50%. Table 4 shows such a contingency table. The test results are somewhat discouraging (see Table 5). In the trend forecast neither the consensus nor the forwards differ from the random forecast. The futures are, statistically speaking, significantly better than tossing a coin at least for the forecast horizons from eight up to and including eleven months.

Table 4: Contingency table used in χ^2 test for independence

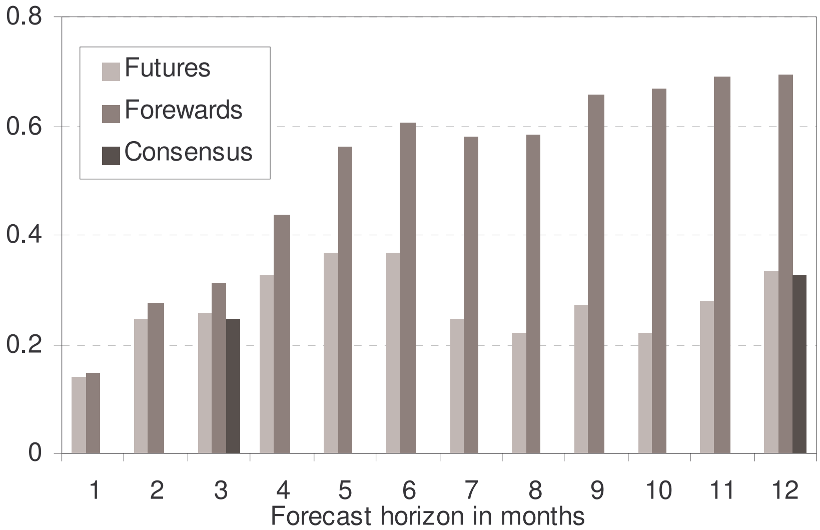
	Actual change is positive	Actual change is negative	
Forecast rising	N_{11}	N_{12}	$N_{1.}$
Forecast falling	N_{21}	N_{22}	$N_{2.}$
	$N_{.1}$	$N_{.2}$	N

Table 5: χ^2 test for quality of trend forecasts

Variable	Number of increases		Number of decreases		Chi-squared test	
	Actual	Forecast	Actual	Forecast	Critical Value	Prob.
ff1	63	84	79	58	0.01	0.92
ff3	50	82	88	56	1.38	0.24
ff6	36	88	101	49	2.46	0.12
ff9	36	93	98	41	4.54	0.03
ff12	27	70	51	8	1.92	0.17
cons3	61	101	102	62	0.00	0.95
cons12	39	99	114	54	2.15	0.14
forward1	82	112	96	66	0.04	0.85
forward3	70	108	106	68	0.93	0.34
forward6	55	106	118	67	2.05	0.15
forward9	52	109	118	61	1.59	0.21
forward12	49	108	118	59	0.68	0.41

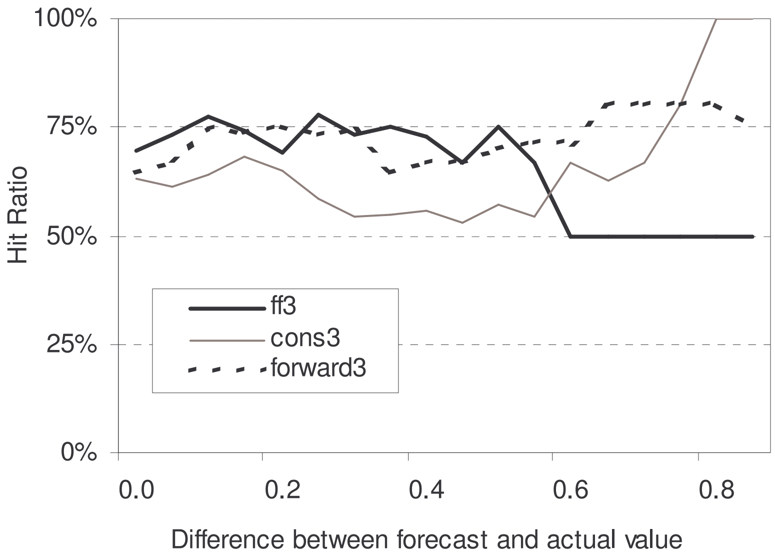
It is possible (c) that the various market forecasts vary in terms of quality during times of rising and falling interest rates. In order to examine this question, we have divided the observation period into regimes of rising and regimes of falling three-month rates. The decision criterion is the actual change over the various forecast horizons. For example, ex post throughout the observation period each month in which the three-month LIBOR rose (fell) in X monthly comparison is taken into account. The other data points are removed from the sample. The data sets so construed — exactly one per forecast horizon and per interest rate direction — are compared with the X month forecast. The identified forecasting errors for rising and falling phases can thus be evaluated separately by forecast horizon. These calculations have brought to light some interesting results (see Figure 3).

Figure 3: Mean forecast error in cycles of rising interest rates



First, the futures — measured on the basis of average forecast error — produce the best forecasts in cross comparison in times of rising interest rates. Other error measurements came to the same conclusion, such as the root mean square error (RMSE), which weights major forecast errors more heavily than minor ones.[3] Only in the 12-month forecast did the consensus prove to be as accurate. Second, it is apparent that for the futures the error does not rise with the forecast horizon, or only marginally so if the RMSE is taken into account. A three-month forecast using futures was thus historically just as good in phases of rising interest rates as a 12-month forecast. However — thirdly — the various interest rate expectations achieve only a very low rate of accuracy (hit ratio). This rate shows how often the forecast increases materialised in the end. Even in short forecast periods — for example with a horizon of three months — the various forecasts did not achieve a rate of accuracy of 50% or more. Nevertheless, this comes as no surprise in view of the secular trend of falling interest rates. Thus the evaluations of regimes with falling interest rates show a reversed picture (see Figure 4). The hit ratio of the various three-month forecasts is at around 75%. It is also striking that the rate of accuracy does not improve much if the forecast is more pronounced (larger difference between forecast and actual value).

Figure 4: Hit ratio when forecasting falling interest rates (3-month forecast, various thresholds)



Overall, our statistical evaluations point to the following conclusion: Market forecasts do not help us much in determining the timing of an interest rate turnaround. If, as is now the case, the next move on interest rates is likely to be an increase in the three-month rates and one does not want to completely ignore market forecasts, then the latter should be read using futures prices.

4. A response function for the SNB's monetary policy and its application options

In the following section we attempt to illustrate the SNB's interest rate policy with the help of a response function. The Taylor rule [4] often used in this connection differs from the concept we selected here in two points. First, the Taylor rule is a normative approach that proposes a money market rate for the current macro-economic climate. Among other things information about the potential growth and the central bank's target inflation rate is necessary to calculate the Taylor rate. Since the first variable in particular cannot be observed directly and must be estimated, the uncertainty is correspondingly very high. We, on the other hand, try to describe the actual interest rate policy using a simple statistical model. Our approach is thus a positive analysis. Second, we use consensus data as the explanatory variable for the interest rate policy. With this we take into account the fact that the central bank must pursue a forward-looking monetary policy. It takes some time — according to empirical tests for Switzerland, between four and eight quarters [5] — until the money market rates have their maximum impact on real economic growth. The inflation rate reacts even later. The SNB thus either reduces or raises interest rates correspondingly, if something in its forecasts changes. We use data on the consensus regarding inflation and real GDP growth. This approach implicitly assumes that the central bank's forecasts do not differ from the average expectations of professional economists. Unfortunately the SNB's published inflation forecasts do not go far enough back in order for us to be able to use the central bank's actual expectations. For the two types of data used, monthly forecasts are available since 1990 for the current and the following year. From this we construct a time series for growth and inflation expectations, with the two forecast horizons variably weighted. The forecast data are calculated as follows (see Figure 5):

$$\mathrm{Exp}_t = \left[(12 - t) * \mathrm{Exp}_t^{y} + t * \mathrm{Exp}_t^{y+1}\right] / 12 \qquad (3)$$

whereas: t = Forecast month (e.g. May: t=5)
Exp_t^{y} = Expectations for this year
Exp_t^{y+1} = Expectations for next year

The weighting of the forecast for the current year thus drops the longer the year has already been underway (the principle of the 12-month forward variables).

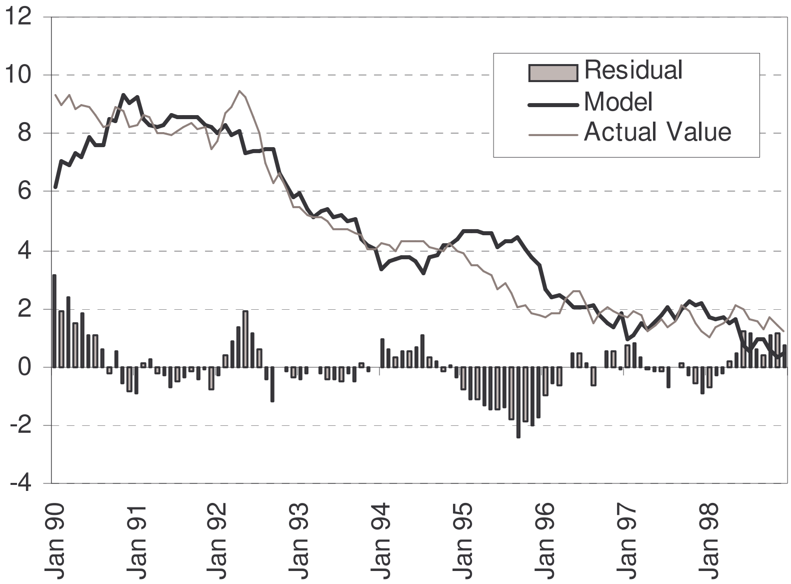
Figure 5: Inflation and growth expectations

We have regressed the expectations for the economy (Exp^{GDP}) and inflation (Exp^{INF}) together with a constant to the three-month rates and set the estimate time span from January 1990 to December 1998 (108 observations). This gave us the following parameters (see Figure 6):[6]

$$\mathrm{Money3m} = -2.0 + 0.5 * \mathrm{Exp}^{GDP} + 2.3 * \mathrm{Exp}^{INF} \qquad (4)$$

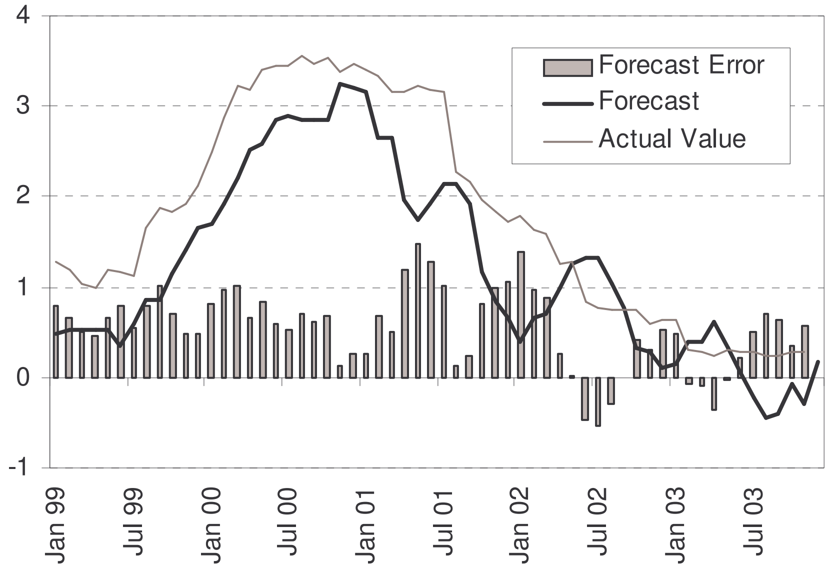
According to these estimates, the SNB weights inflation expectations four times as heavily as growth expectations in its interest rate policy. Such a long-term relationship is commensurate with the targets of Swiss monetary policy. In the past there were two phases in which money market rates diverged sharply from the estimated values according to the above long-term relationship. In the first phase at the beginning of the 1990s, the German Bundesbank's restrictive monetary policy in the wake of reunification in particular led to European interest rates that did not match the economic realities in many countries. This was also the case in Switzerland. In the second phase in around 1995, we believe that the divergence of money market rates from their fundamental value could be traced back to the sharp decline in money supply growth. At the time the SNB formally pursued an indirect target via money supply.

Figure 6: Money market rate and response function



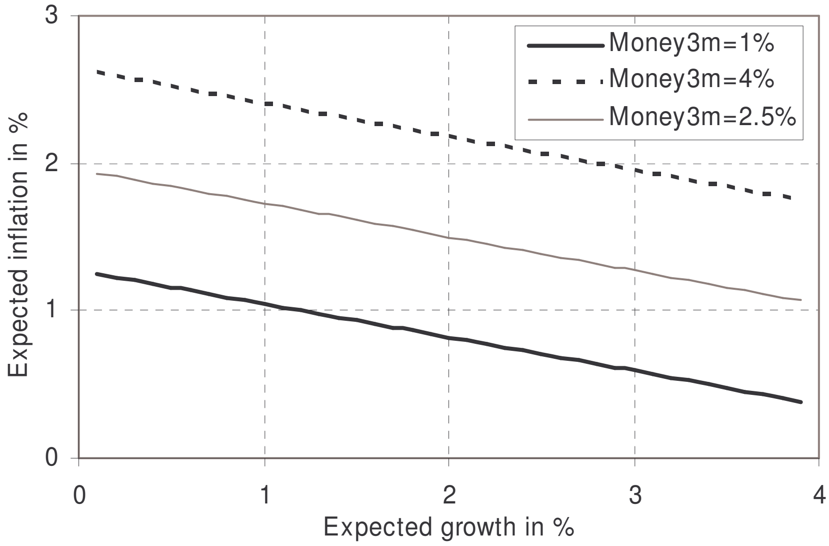
An important requirement of our response function is the stability of the implied relationships. Hence the estimated weighting factors, which were determined in-sample, must be able to describe the movements of the money market rates by using the realised forecasts as of 1999 (out-of-sample forecasts). Figure 7 shows the results. The most important conclusion first: The model can recognise the entire interest rate cycle with mounting money market rates as of the third quarter of 1999, with interest rates peaking towards the end of 2000 and the subsequent phase with a trend of falling money market rates. This is a considerable accomplishment for such a long time period — no less than five years. Nevertheless there are some weak points. The model recognised the rising phase but underestimated the increase by an average of almost 75 basis points. The relative increase — i.e. compared with the starting level — was satisfactorily predicted. The model also sent four false signals in the phase of falling interest rates since the beginning of 2001. Between January and June of 2002, the model even pointed to rising interest rates of one percentage point. In this phase, sentiment indicators improved clearly worldwide. The consequences were rising growth and inflation expectations. A wave of accounting scandals and emerging concerns about a war with Iraq kept the upswing from materialising, so that shortly thereafter expectations were revised downwards again. The three other false signals, rises of around 50 basis points, were much less extreme. As a result we conclude that the signals must be very clear in order to ensure a sufficient basis for making decisions. In the following scenario analysis, we estimate the various reactions of the SNB to changes in expectations.

Figure 7: Out-of-sample forecasts for interest rate cycle starting in 1999



With the help of our response function, it is possible to generate a “iso-yield curve system”. Figure 8 has lines showing all combinations of growth and inflation expectations, in which the SNB keeps interest rates constant at a certain level.

Figure 8: Iso-yield curves of the SNB according to response function



The slopes in Figure 8 signal the different priorities of the inflation or growth expectations in the SNB’s decision-making process. A possible application is scenario analyses. These are based on the assumption of historically consistent behaviour on the part of the SNB; in future the SNB will behave similarly to the way it did in the past given an unchanged macro-economic outlook.

As we can see in Table 6, various macro scenarios can be assigned to the corresponding money market rates. The importance of inflation expectations was obvious. Hence money market rates of between 0% and 5% can be assigned to a given growth outlook of 1.8 — similar to that at the current time. The calculations also show that if deflation expectations are present, i.e. an anticipated inflation rate of minus 0.5 percent, the money market rates would be at zero regardless of the state of the economy. Our response function serves, in the end, as a rule of thumb to estimate roughly a consistent interest rate level.

Table 6: Money market rates with alternative inflation and growth expectations

		Inflation expectations				
		0.6%	1.0%	1.5%	2.5%	-0.5%
Growth expectations	-0.5%	0.0%	0.0%	1.2%	3.5%	0.0%
	0.0%	0.0%	0.3%	1.5%	3.8%	0.0%
	1.8%	0.3%	1.2%	2.4%	4.7%	0.0%
	2.5%	0.6%	1.6%	2.7%	5.0%	0.0%
	3.0%	0.9%	1.8%	3.0%	5.3%	0.0%
	3.5%	1.1%	2.1%	3.2%	5.5%	0.0%

5. Conclusion

This report provides assistance in forecasting Swiss monetary policy. The analysis of various market expectations provides sobering results. The market forecasts — regardless of how they are actually measured — show statistically significant and systematic forecast errors. Even in the simple trend forecast for money market rates, they only seldom beat the toss of a coin. If one divides the observation periods into phases of rising and falling interest rates, the futures forecasts prove superior to the other two methods. First, they result in smaller forecast errors, and second, the forecasting quality does not deteriorate with the forecast period. However, this method is unable to replace an assessment of the central bank's decision-making considerations.

We approached the question of a potential rise in yields in rising interest rate cycles in a first step by observing historical increasing phases. In the four periods since 1979, the average rise in key interest rates came to three percentage points. Nonetheless, there are major differences among the periods, and hence the "average cycle" is not of much assistance. In a second step, we attempted to describe the SNB's monetary policy using a response function. Based on the forward-looking character of monetary policy, we used expectations data as the explanatory variables. Our analysis points to a stable interest rate policy on the part of the SNB, with inflation expectations being more than four times as heavily weighted as growth expectations. This response function permits us to draw conclusions about the yield level on the money market with given macro-economic expectations. However, the conclusions are based on the assumption that the SNB will behave similarly as it did in the past. If the inflation outlook stays at its current, low level, even a sharp increase in growth forecasts does not necessarily mean the Swiss National Bank will see any significant need to hike interest rates. Merely a small increase in inflation expectations would, however, have major implications for monetary policy.

FOOTNOTES

[1] The approach of testing for lack of bias in the first step and testing the quality of the trend forecasts in the second step was used in a similar manner by BOFINGER/SCHMIDT (2003) in their evaluation of exchange rate forecasts.

[2] For a more detailed description of this test, please refer to e.g. DIEBOLD/LOPEZ (1996).

[3] See e.g. GREENE (2003) for details on calculating RMSE.

[4] This rule, much discussed in the literature, is based on TAYLOR (1993).

[5] See ROTH (2003).

[6] The variables used cannot with certainty – a margin of error of 5% – be classified as stationary, and hence it would seem appropriate to estimate an error correction model. The equation (4) can therefore be interpreted as a long-term relationship; first, the residuals of the equation are stationary (ADF statistic: -3.59; critical value according to the cointegration test of MACKINNON (1991) -3.39, according to ENGLE/YOO (1987) -3.62), proving a cointegration relationship between the variables on the basis of a margin of error of a good 5% (the critical values specified for the standard Dickey-Fuller case of a directly observable time series are not correct since OLS residuals are used here). Second, the analysis of the short-term relationship shows that the coefficient of the error term of the long-term equation is less than zero (-0.062, t-statistic: -1.82), which is statistically significant. This means that the money market rates, after diverging from equilibrium in the long-term relationship, will converge back to this relationship and that this adjustment process lasts an average 16 months. According to the specifications of the short-term relationship, the error terms clearly show the “white noise” characteristic. Our stability investigations for the coefficients, such as the CUSUM test of squares of BROWN et. al. (1975), show good results and indicate that the SNB did not make any structural changes in its monetary policy in the time period under review. Since both explanatory variables (inflation and growth expectations) show a positive correlation with one another in the long term, the simultaneous application of both factors poses the risk of an identification problem. According to the condition number of BESLEY et al. (1980), however, multicollinearity does not pose a problem in the specified long-term relationship. This is also true for the analysis of selected sub-samples. Both non-stationary time series can therefore be used together as explanatory variables.

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